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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

"Package having an inflated frame"

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PACKAGE HAVING AN INFLATED FRAME

* * * * * * *

BACKGROUND OF THE INVENTION

The present invention relates to packaging having a chamber portion for containing a product and an inflated frame surrounding the chamber, and to methods of making such packaging.

It is common in food packaging operations for a food product (e.g., fresh meat) to be placed on a rigid tray (e.g., a thermoformed expanded polystyrene tray having a central depressed area and a surrounding peripheral flange). A thermoplastic film may then be positioned over the food and heat sealed to the peripheral flange to hermetically enclose the food product.

However, a high percentage of the final packaging costs for such packaging systems is due to the relatively high cost of such trays. Further, there are costs and inconveniences associated with transporting and storing the trays before their use in the packages. Also, such trays add to the volume of packaging waste material with which the consumer must deal after opening the package.

SUMMARY OF THE INVENTION

The present invention addresses one or more of the aforementioned problems.

A package for containing a product includes top and bottom opposing flexible chamber sheets. These sheets are sealed together in a selected chamber seal zone to define a watertight chamber portion that is capable of containing the product. A hollow frame circumscribes the chamber portion. The frame supports the chamber portion when the frame is inflated.

A process of packaging includes the following steps: 1) providing a base web comprising a flexible sheet material; 2) placing a product on the base web; 3) positioning over the product a lid web comprising a

flexible sheet material; 4) sealing the lid web to the base web at a selected chamber seal zone to form a chamber portion enclosing the product; and 5) sealing the lid web to the base web at one or more selected frame seal zones to form a hollow frame circumscribing the chamber portion and adapted to support the chamber portion when the frame is inflated.

The need for a rigid tray may be eliminated by the inventive package, so that the package may be considered "tray-less."

These and other objects, advantages, and features of the invention will be more readily understood and appreciated by reference to the detailed description of the invention and the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view of a package of the present invention having the frame in an inflated state and a modified atmosphere in the chamber portion;

Fig. 2 is a sectional view taken along line 2-2 of Fig. 1;

Fig. 3 is a plan view of a package of the present invention having inflation a frame inflation passageway and a chamber inflation passageway;

Fig. 4 is a representative schematic of a process line for making a package of the present invention;

Fig. 5 is a representative sectional view of the vacuum/gas-flush/sealing/inflation chamber of Fig. 4 in the chamber open mode;

Fig. 6 is a representative sectional view of the vacuum/gas-flush/sealing/inflation chamber of Fig. 4 in the chamber close mode;

Fig. 7 is a representative sectional view of the vacuum/gas-flush/sealing/inflation chamber of Fig. 4 in the chamber portion seal mode;

Fig. 8 is a representative sectional view of the vacuum/gas-flush/sealing/inflation chamber of Fig. 4 in the frame seal mode;

Fig. 9 is a representative sectional view of the vacuum/gas-flush/sealing/inflation chamber of Fig. 4 in the chamber open mode with a formed package of the present invention;

Fig. 10 is a representative sectional view of a package of the present invention having a thermoformed base sheet;

Fig. 11 is a representative sectional view of a thermoforming station; and

Fig. 12 is a representative sectional view of another thermoforming station.

DETAILED DESCRIPTION OF THE INVENTION

Package 10 comprises a chamber portion 12 circumscribed by a hollow frame 14. (Figs. 1-2.) The chamber portion 12 may be "watertight" (i.e., does not permit leakage or permeation of liquid water except if subjected to structural discontinuity) and further may be "airtight" or "hermetic" (i.e., does not permit permeation of oxygen at a rate above 1000 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C, unless subjected to structural discontinuity). Chamber portion 12 is capable of or adapted to contain product 16. The chamber portion 12 may include a top chamber sheet 18 and a bottom chamber sheet 20, which may be juxtaposed and sealed together at a chamber seal zone 22 to form the chamber portion 12. The terminology "top" and "bottom" sheets as used in this application includes the sense of one sheet of material folded over upon itself to form the top and bottom sheets.

Hollow frame 14, which is shown in an inflated state in Fig. 2, circumscribes chamber portion 12. The frame 14 is adapted to support the chamber portion 12 when the frame 14 is inflated. Frame 14 may be in form of a continuous tube surrounding the chamber portion 12, as shown in Fig. 1, or may comprise one or more discrete chambers (not

shown) so that one chamber of the frame may deflate without deflating the entire frame. Frame 14 may include a top frame sheet 26 and a bottom frame sheet 28, which may be juxtaposed and sealed together at a frame inner seal zone 30 and a frame outer seal zone 32 to form frame 14.

As illustrated in Fig. 2, lid sheet 34 extends continuously from the frame to the chamber portion, thereby including both top chamber sheet 18 and top frame sheet 26. Also as illustrated in Fig. 2, base sheet 36 extends continuously from the frame to the chamber portion, thereby including both bottom chamber sheet 20 and bottom frame sheet 28. The lid sheet 34 may be formed from a lid web 38 (Fig. 4) and the base sheet 36 may be formed from a base web 40 (Fig. 4). As used herein, a "web" is a continuous length of sheet material handled in roll form, as contrasted with the same material cut into short lengths.

In order to support chamber portion 12 when frame 14 is inflated, frame 14 may be attached to the exterior perimeter of chamber portion 12, for example, by one or more heat or adhesive seals, or by a tape (not shown) or other mechanical linkage attaching frame 14 to the chamber portion 12. For example, as illustrated in Fig. 2, frame 14 is attached to the chamber portion 12 by virtue of lid sheet 34 and base sheet 36, which extend continuously from frame 14 to chamber portion 12 to attach frame 14 to chamber portion 12. Either or both of the lid and base sheets may extend continuously from the frame to the chamber portion to attach the frame 14 to the chamber portion 12.

Frame inner seal zone 30 may be coextensive with chamber portion seal zone 22, as illustrated in Figs. 1-2. Alternatively, the frame inner seal zone 30 may be spaced apart from chamber portion seal zone 22 or may be adjacent to chamber portion seal zone 22. If lid sheet 34 is sealed to base sheet 36 so that frame inner seal zone 30 is coextensive with chamber portion seal zone 22, then the frame 14 and chamber

portion 12 may share a common seal, as illustrated in Fig. 2. In such case, the frame inner seal zone 30 may be said to include or comprise chamber portion seal zone 22 – or chamber portion seal zone 22 may be said to include or comprise frame inner seal zone 30.

The sheets (i.e., top and bottom chamber sheets, top and bottom frame sheets, lid and base sheets) may be sealed together at any of the seal zones (e.g., chamber seal zone 22, the frame inner seal zone 30, and the frame outer seal zone 32) by any method, such as heat sealing (e.g., conductance sealing, impulse sealing, ultrasonic sealing, dielectric sealing) or by application of a suitable adhesive (e.g., a UV-curable adhesive) (not shown) between the sheets in the applicable seal zone. Such methods are well known to those of skill in the art.

As illustrated in another embodiment shown in Fig. 3, package 11 includes a frame inflation passageway 42 attached to frame 14 to provide access to the interior of hollow frame 14 for inflating the frame. Accordingly, frame inflation passageway 42 may be connected to one or more portions of frame 12 and be in fluid communication with the interior space of frame 14. A chamber inflation passageway 44 may be attached to chamber portion 12 to provide access to the interior space of chamber portion 12 for introducing a modified atmosphere into the interior space of chamber portion 12. Chamber inflation passageway 44 may be connected to one or more portions of chamber portion 12 and be in fluid communication with the interior space of chamber portion 12. Examples of frame inflation passageway 42 and chamber inflation passageway 44 include sealable inflation passageways or one-way inflation valves, for example, as illustrated in U.S. Patent 6,276,532 by Sperry et al, which is incorporated herein in its entirety by reference.

As illustrated in another embodiment shown in Figure 10, package 13 includes a thermoformed bottom chamber sheet 21 and a thermoformed bottom frame sheet 29, which may be provided as

thermoformed base sheet 37. The thermoformed bottom chamber sheet 21 may provide a configuration adapted for convenient placement of, or conformance to, product 16 within chamber portion 12.

Modified Atmosphere

Package 10 may include a modified atmosphere 24 in the chamber portion 12, for example, so that product 16 may be packaged in modified atmosphere 24. A modified atmosphere may be useful, for example, to decrease the concentration of oxygen from that of ambient air or to increase the concentration of oxygen and carbon dioxide from that of ambient air in order to extend a packaged product's shelf-life or bloom color life. For example, in packaging meat, the atmosphere in the sealed package may comprise about 80% by volume oxygen and about 20% by volume carbon dioxide in order to inhibit the growth of harmful microorganisms and extend the time period in which the meat retains its attractive red ("bloom") coloration. As used herein, the term "modified atmosphere" refers to a gas environment having a composition that is altered from that of ambient air for the purpose of extending the shelf life, enhancing the appearance, or reducing the degradation of a packaged product.

Examples of modified atmosphere 24 include gas environments having an oxygen concentration (by volume): 1) greater than about any of the following values: 30%, 40%, 50%, 60%, 70%, 80%, and 90%, 2) ranging between any of the preceding values (e.g., from about 30% to about 90%), 3) no more than about any of the following values: 15%, 10%, 5%, 1%, and 0%, and 4) ranging between any of the preceding values (e.g., from about 0% to about 15%). A modified atmosphere may also include gas environment having a carbon dioxide concentration of greater than about any of the following values: 10%, 20%, 30%, 40%, and 50% by volume. The modified atmosphere 24 may also include

non-ambient amounts of one or more gases selected from argon, nitrogen, and helium.

Packaged Product

Package 10 may include a product 16 within chamber portion 12 (i.e., within the interior space of chamber portion 12). Product 16 may comprise a food or a non-food item. Product 16 may primarily comprise an oxygen-sensitive item (i.e., an item that is perishable, degradable, or otherwise changeable in the presence of oxygen). Examples of oxygen-sensitive products or items include red meat (e.g., beef, veal, and lamb), processed meat, pork, poultry, fish, cheese, and vegetables. Package 10 may also include an absorbent pad (not shown) within chamber portion 12, for example, to absorb meat purge.

Sheet Construction

As used herein, "the sheets" refers to any of the top and bottom chamber sheets 18, 20, top and bottom frame sheets 26, 28, and lid and base sheets 34, 36. Any of the sheets may comprise one or more thermoplastic polymer materials such as polyolefins, polystyrenes, polyurethanes, polyamides, polyesters, polyvinyl chlorides, and ionomers.

Useful polyolefins include ethylene homo- and co-polymers and propylene homo- and co-polymers. Ethylene homopolymers include high density polyethylene ("HDPE") and low density polyethylene ("LDPE"). Ethylene copolymers include ethylene/alpha-olefin copolymers ("EAOs") and ethylene/unsaturated ester copolymers. ("Copolymer" as used in this application means a polymer derived from two or more types of monomers, and includes terpolymers, etc.)

EAOs are copolymers of ethylene and one or more alpha-olefins, the copolymer having ethylene as the majority mole-percentage content. The comonomer may include one or more C_3-C_{20} α-olefins, such as one or

more C_4-C_{12} α-olefins, or one or more C_4-C_8 α-olefins. Useful α-olefins include 1-butene, 1-hexene, 1-octene, and mixtures thereof.

EAOs include one or more of the following: 1) medium density polyethylene ("MDPE"), for example having a density of from 0.93 to 0.94 g/cm3; 2) linear medium density polyethylene ("LMDPE"), for example having a density of from 0.926 to 0.94 g/cm3; 3) linear low density polyethylene ("LLDPE"), for example having a density of from 0.915 to 0.930 g/cm3; 4) very-low or ultra-low density polyethylene ("VLDPE" and "ULDPE"), for example having density below 0.915 g/cm3, and 5) homogeneous EAOs. Unless otherwise indicated, all densities herein are measured according to ASTM D1505.

The polyethylene polymers may be either heterogeneous or homogeneous. As is known in the art, heterogeneous polymers have a relatively wide variation in molecular weight and composition distribution; whereas, homogeneous polymers have a relatively narrow variation in molecular weight and composition distribution. Heterogeneous polymers may be prepared with, for example, conventional Ziegler Natta catalysts. On the other hand, homogeneous polymers are typically prepared using metallocene or other single site-type catalysts.

Another useful ethylene copolymer is ethylene/unsaturated ester copolymer, which is the copolymer of ethylene and one or more unsaturated ester monomers. Useful unsaturated esters include: 1) vinyl esters of aliphatic carboxylic acids, where the esters have from 4 to 12 carbon atoms (e.g., vinyl acetate), and 2) alkyl esters of acrylic or methacrylic acid (collectively, "alkyl (meth)acrylate"), where the esters have from 4 to 12 carbon atoms.

Useful propylene copolymer includes propylene/ethylene copolymers ("EPC"), which are copolymers of propylene and ethylene having a majority weight % content of propylene, such as those having an

ethylene comonomer content of less than 10%, preferably less than 6%, and more preferably from about 2% to 6% by weight.

Examples of useful polyesters include amorphous (co)polyesters, poly(ethylene/terephthalic acid), and poly(ethylene/naphthalate). Poly(ethylene/terephthalic acid) with at least about 75 mole percent, more preferably at least about 80 mole percent, of its mer units derived from terephthalic acid may be preferred.

Any of the sheets may be mono- or multi-layered. If a sheet is multilayered, then the sheet may include one or more outer layers of a heat-sealable material to assist in heat sealing the sheets together, as is known in the art. Such a sealant layer may include one or more of the thermoplastic polymers discussed in this patent application.

Barrier Attributes

It may be advantageous for any, or one or more, of the sheets (or a layer of the sheets) to have gas (e.g., oxygen, carbon dioxide) barrier attributes to decrease the gas permeability of the sheet. Barrier attributes for the sheets may be useful, for example: i) to increase the inflated life of frame 14, ii) to enhance the storage life of a packaged product 16 contained within chamber portion 12 that may degrade upon exposure to oxygen (e.g., red meat), and iii) to help maintain a modified atmosphere 24 that may be contained within chamber portion 12.

Any, or one or more, of the sheets may include one or more materials ("barrier components") that markedly decrease the oxygen or carbon dioxide transmission rate through the sheet and thus impart barrier attributes to the sheet. (Since carbon dioxide barrier properties generally correlate with oxygen barrier properties, only oxygen barrier properties are discussed in detail herein.) Examples of barrier components include: ethylene/vinyl alcohol copolymer ("EVOH"), polyvinyl alcohol ("PVOH"), vinylidene chloride polymers ("PVdC"),

polyalkylene carbonate, polyester (e.g., PET, PEN), polyacrylonitrile ("PAN"), and polyamide.

EVOH may have an ethylene content of between about 20% and 40%, preferably between about 25% and 35%, more preferably about 32% by weight. EVOH may include saponified or hydrolyzed ethylene/vinyl acetate copolymers, such as those having a degree of hydrolysis of at least 50%, preferably of at least 85%.

Vinylidene chloride polymer ("PVdC") refers to a vinylidene chloride-containing polymer or copolymer -- that is, a polymer that includes monomer units derived from vinylidene chloride ($CH_2 = CCl_2$) and also, optionally, monomer units derived from one or more of vinyl chloride, styrene, vinyl acetate, acrylonitrile, and C_1 -C_{12} alkyl esters of (meth)acrylic acid (e.g., methyl acrylate, butyl acrylate, methyl methacrylate). As is known in the art, one or more thermal stabilizers and lubricating processing aids may be used in conjunction with PVdC.

If a sheet is multilayered, then the one or more layers of the sheet that incorporate barrier components in an amount sufficient to notably decrease the oxygen permeability of the sheet are considered "barrier layers. "If the sheet is monolayered, then the barrier components may be incorporated in the sole layer of the sheet and the sheet itself may be considered a "barrier layer".

A useful barrier layer includes that having a thickness and composition sufficient to impart to the sheet incorporating the barrier layer an oxygen transmission rate of no more than about any of the following values: 150, 100, 50, 45, 40, 35, 30, 25, 20, 15, 10, and 5 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C. All references to oxygen transmission rate in this application are measured at these conditions according to ASTM D-3985. For example, top and bottom chamber

sheets 20, 22 may each have a thickness and composition sufficient to impart to each of the sheets any of the oxygen transmission rates previously recited.

Sheet Attributes

The sheets may have any thickness suitable for the packaging application – preferably taking into consideration factors such as the desired inflation pressure of the frame and/or chamber portion, the tensile strength of the sheet material, the hoop stress resulting from the given inflated configuration of the frame and/or chamber portion, the amount of abuse expected for the application, and the desired gas permeation rate through the sheets. Useful sheet thickness ranges include from about 0.5 to about 10 mils, and from about 3 to about 8 mils.

Any or all of the sheets may have one or more of the characteristics selected from flexible, stretchable, extendable, and elastic. For example, a sheet may be stretched by inflation. The sheets preferably exhibit a Young's modulus sufficient to withstand the expected handling and use conditions. Young's modulus may be measured in accordance with one or more of the following ASTM procedures: D882; D5026-95a; D4065-89, each of which is incorporated herein in its entirety by reference. Any or all of the sheets may have a Young's modulus of at least about any of the following values: 100 MPa, 200 MPa, 300 MPa, and 400 MPa, measured at 100°C. The Young's modulus for the sheets may also range from about 70 to about 1000 MPa, and range from about 100 to 500, measured at 100°C.

Any or all of the sheets may be oriented in either the machine (i.e., longitudinal) or the transverse direction, or in both directions (i.e., biaxially oriented), in order to reduce the permeability and to increase the strength and durability of the sheet. For example, the sheet may be oriented in at least one direction by a ratio of any of the following: at

least 2.5:1, from about 2.7:1 to about 10:1, at least 2.8:1, at least 2.9:1, at least 3.0:1, at least 3.1:1, at least 3.2:1, at least 3.3:1, at least 3.4:1, at least 3.5:1, at least 3.6:1, and at least 3.7:1.

Any or all of the sheets may be heat shrinkable or non-heat shrinkable. If heat shrinkable, the sheets may have a total free shrink at 185°F (85°C) of at least about any of the following values: 5%, 10%, 15%, 40%, 50%, 55%, 60%, and 65%. The total free shrink at 185°F (85°C) may also be within any of the following ranges: from 40 to 150%, 50 to 140%, and 60 to 130%. The total free shrink is determined by summing the percent free shrink in the machine (longitudinal) direction with the percentage of free shrink in the transverse direction. For example, a sheet which exhibits 50% free shrink in the transverse direction and 40% free shrink in the machine direction has a total free shrink of 90%. It is not required that the sheet have shrinkage in both directions. The free shrink of the sheet is determined by measuring the percent dimensional change in a 10 cm x 10 cm sheet specimen when subjected to selected heat (i.e., at a certain temperature exposure) according to ASTM D 2732, which is incorporated herein in its entirety by reference. The sheets may be annealed or heat-set to reduce the free shrink either slightly, substantially, or completely; however, a sheet may not be heat set or annealed once stretched if it is desired that the sheet have a high level of heat shrinkability.

Any or all of the sheets may incorporate or have dispersed in effective amounts one or more antifog agents in the sheet resin before forming the resin into a sheet, and in the case of a multilayer sheet, may incorporate antifog agent in one or more of the outer layers of the sheet. The antifog agent may also be applied as an antifog coating to at least one surface of the sheet. Useful antifog agents and their effective amounts are well known in the art.

Any of the sheets, for example, the top chamber sheet 18 and/or top frame sheet 26, may be transparent to visible light to enable a consumer to see the packaged product in the areas where the sheet does not support a printed image (e.g., labeling information). "Transparent" as used herein means that the material transmits incident light with negligible scattering and little absorption, enabling objects (e.g., packaged product or print) to be seen clearly through the material under typical viewing conditions (i.e., the expected use conditions of the material). Also, any of the sheets may be opaque, colored, or pigmented. For example, the bottom chamber sheet 20 and/or bottom frame sheet 28 may be opaque, colored, or pigmented to provide a background for the packaged product 16 or to simulate the appearance of a conventional meat tray.

Useful films for forming the sheets may be selected from one or more of the films disclosed in International Patent Application Publication No. WO 01/68363 A1 published 20 September 2001 entitled "Bi-Axially Oriented and Heat-Set Multilayer Thermoplastic Film for Packaging" and U.S. Patent 6,299,984 issued 9 October 2001 entitled "Heat-Shrinkable Multilayer Thermoplastic Film" (corresponding to EP 0 987 103 A1 published 22 March 2000). Each of the foregoing publications are incorporated herein in its entirety by reference. Another useful thermoplastic film structure has nine layers and a total thickness of 150 microns (6 mils); the film has the following structure:

Film Layer:	1	2	3	4	5	6	7	8	9
Composition:	LLDPE1	LLDPE2	PP	PP	PP	PP	PP	EVOH	PA6
Thickness: (microns)	13.5	30	6	21	15	21	6	15	22.5

where:

LLDPE1 is linear low density polyethylene also containing slip and antiblock additives;

LLDPE2 is linear low density polyethylene;

PP is polypropylene;
EVOH is ethylene/vinyl alcohol copolymer; and
PA6 is Nylon 6.

Packaging Machine

The package 10 may be formed using packaging machine 74 (Figure 4). Packaging machine 74 includes base unwind mandril 45 that supports base web roll 46 so that base web 40 may be fed to vacuum/gas-flush/sealing/inflation chamber 48 (i.e., "seal chamber 48"). Lid unwind mandril 51 supports lid web roll 50 so that lid web 38 may also be fed to seal chamber 48.

Seal chamber 48 includes top chamber casing 52 and opposing bottom chamber casing 54. The top and bottom chamber casings are moveable relative each other to a chamber open mode, illustrated in Figures 5 and 9, and a chamber closed mode, illustrated in Figures 6-8. In the chamber open mode, the top and bottom casings are spaced apart to allow the lid and base webs 38, 40 and product 16 to enter seal chamber 48. In the chamber closed mode, top and bottom casings 52, 54 are proximate each other to form an enclosed chamber volume 68.

Top chamber casing 52 may enclose and slideably receive both inner seal bar 56 and outer seal bar 58. Bottom chamber casing 54 may support seal anvil 60, which opposes both the inner and outer seal bars. Inner seal bar 56 and seal anvil 60 are moveable relative each other between an inner seal bar engaged position and an inner seal bar disengaged position. In the inner seal bar engaged position, illustrated in Figures 7-8, inner seal bar 56 and seal anvil 60 are proximate each other to define inner seal chamber volume 70 and outer seal chamber volume 72. In the inner seal bar disengaged position, illustrated in Figure 6, the inner seal bar 56 and seal anvil 60 are spaced apart.

Similarly, outer seal bar 58 and seal anvil 60 are moveable relative each other between an outer seal bar engaged position and an outer

seal bar disengaged position. In the outer seal bar engaged position, illustrated in Figure 8, outer seal bar 58 and seal anvil 60 are proximate each other. In the outer seal bar disengaged position, illustrated in Figures 6 and 7, the outer seal bar 58 and seal anvil 60 are spaced apart.

Seal chamber 48 includes a vacuum source 62, a modified atmosphere source 64, and an inflation gas source 66, each of which is capable of controlled fluid communication with seal chamber 48, as discussed further below.

Cutter 76 is downstream from the seal chamber 48. Suitable cutters are well known in the art and include, for example, rotary cutters, knife cutters, cutting blades, and laser cutters.

Manufacture of the Package

In the operation of packaging machine 74, the base web 40 is unwound from base web roll 46 supported by base unwind mandril 45 and is fed to the seal chamber 48. The base web 40 may be pulled along by gripping chains (not shown) at two sides, as is known in the art. Product 16 may be placed on base web 40 before the web is fed to seal chamber 48. Lid web 38 is unwound from lid web roll 50 supported by lid unwind mandril 51 and is also fed to seal chamber 48. The lid web 38 may also be pulled along by gripping chains (not shown) at two sides, as is known in the art. At least a portion of lid web 38 may be positioned over product 16, either before or after product 16 enters seal chamber 48.

The lid and base webs 38, 40 on either side of product 16 are positioned between the top chamber casing 52 and bottom chamber casing 54 while the seal chamber 48 is in the chamber open mode (Figure 5). Next, the seal chamber 48 moves to a chamber closed mode so that top and bottom chamber casings 52, 54 engage, compress, or squeeze the lid and base webs 38, 40 between them and as a result

form three essentially airtight enclosed chamber volumes: upper chamber volume 68 (which is a volume above web 38), lower chamber volume 69 (which is a volume below web 40), and intermediate chamber volume 67 (which is a volume between webs 38 and 40 enclosing product 16). (Figure 6.) Optionally, upper and lower chamber volumes 68, 69 may be placed in fluid communication by appropriate piping, tubing, or other means, as is known in the art.

In the chamber closed mode (Figure 6), a vacuum may be pulled on the enclosed intermediate chamber volume 67 to evacuate a desired amount of enclosed ambient air through vacuum source 62. Next, a modified atmosphere of a desired composition and amount may be introduced into intermediate chamber volume 67 through modified atmosphere source 64. The modified atmosphere may be introduced at a temperature lower than the ambient temperature, so that upon later warming to ambient temperature, the modified atmosphere within chamber portion 12 may obtain an above-ambient pressure.

It may be desirable to maintain a balanced force on the upper and lower webs (i.e., avoid ballooning of the intermediate chamber volume 67) when introducing modified atmosphere into intermediate chamber volume 67. To do so, the pressure in the upper and lower chamber volumes 68, 69 may be increased by introducing a gas (e.g., air or modified atmosphere) into those chamber volumes when introducing modified atmosphere into intermediate chamber volume 67.

Subsequently, inner seal bar 56 and seal anvil 60 move to the inner seal bar engaged position (Fig. 7) to compress lid and base webs 38, 40 between them and also to define inner seal chamber volume 70, outer seal chamber volume 72, and frame volume 73 (between the lid and base webs). The inner seal bar is heated to a temperature effective to heat seal the webs together in chamber seal zone 22 (*see* Figure 2).

In so doing, chamber portion 12 is formed enclosing modified atmosphere 24 and product 16 (*see* Figure 2).

Next, an inflation gas is introduced into the frame volume 73 through inflation gas source 66. Suitable inflation gas includes, for example, air, nitrogen, or modified atmosphere (including modified atmosphere having the same composition as that introduced through modified atmosphere source 64, as discussed above). An amount of inflation gas is added to elevate the pressure within frame volume 73 to a desired amount, for example, a gauge pressure of at least about any of the following values: 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.8, and 1 bar; a gauge pressure of less than about 2 bar; and a gauge pressure ranging between any of the forgoing values (e.g., from about 0.2 bar to about 0.8 bar, and from about 0.3 bar to about 2 bar).

It may also be desirable to maintain a balanced force on the upper and lower webs (i.e., avoid premature ballooning of the frame volume 73) when introducing inflation gas into frame volume 73. To do so, the pressure in the outer seal chamber volume 72 may be increased by introducing an inflation gas into that chamber volume when introducing inflation gas into frame volume 73.

Turning to Figure 8, outer seal bar 58 and seal anvil 60 move to the outer seal bar engaged position (Fig. 8) to compress lid and base webs 38, 40 between them. The outer seal bar is heated to a temperature effective to heat seal the webs together in frame outer seal zone 32 (*see* Figure 2). In so doing, hollow frame 14 is formed enclosing the inflation gas at the elevated pressure.

Next, the inner and outer seal chamber volumes 70, 72 and lower chamber volume 69 may be vented to release at least a portion of the modified atmosphere and inflation gas that has not been captured within chamber portion 12 and frame 14. Then, the top and bottom chamber casings return to the chamber open mode, with inner seal bar

56 and seal anvil 60 in the disengaged position and outer seal bar 58 and seal anvil 60 in the disengaged position, as illustrated in Figure 9.

Upon exposure to ambient pressure, frame 14 takes on an inflated condition since the pressure within frame 14 is greater than the ambient pressure. In taking on an inflated condition, frame 14 tries to pull away from chamber portion 12, thus creating a tension that provides some stiffness or rigidity to the package 10 and to chamber portion 12 (containing the modified atmosphere) relative to the state where frame 14 is not inflated. The pressure within frame 14 may be any of the pressures mentioned above with respect to the pressure within outer seal chamber volume 72.

Lid and base webs may be indexed forward so that cutter 76 (Figure 4) may sever the webs to release package 10. The cutter may cut the webs, for example, by butt or die cuts as is known in the art. Although the cutter 76 is illustrated in Figure 4 as downstream from seal chamber 48, the cutter may alternatively be located just upstream of the seal chamber 48. The packaging machine 74 may operate in an indexed and/or essentially continuous manner, to produce numerous packages 10 from the lid and base web rolls.

The manufacture of thermoformed package 13 (Fig. 10) may include the use of a thermoforming station to thermoform a portion of the base web 40 upstream from the point where product 16 is placed on the web. Thermoforming stations and thermoforming methods are well known in the art, and include positive or negative vacuum forming and positive or negative compressed air forming, any of which may be used with or without mechanical pre-stretching and with or without plug assist. For example, the packaging machine illustrated in Figure 4 may be modified to include a thermoforming station, such as that represented by thermoform station 80 (Figure 11) having mold 82 and opposing plug 84, which cooperate to form base web into a desired shape, such as the

shape of the thermoformed base sheet 37 (which in Figure 10 includes thermoformed bottom chamber sheet 21 and thermoformed bottom frame sheet 29). Another example of a suitable thermoforming station is represented by thermoform station 80 (Figure 12) having forming mold 88, opposing hot plate 90, and enclosing top and lower chambers 92, 94. Thermoform station 80 may also be used to form base web into a desired shape, such as the shape of the thermoformed base sheet 37 (Figure 10). Base web 40 may be formed into a series of tray shapes having flanges to facilitate the sealing of the lid web 38 to the base web 40. The bottom frame sheet may or may not be thermoformed.

In the embodiment illustrated in Figure 3, modified atmosphere 24 is introduced into chamber 12 by the chamber inflation passageway 44, which is sealed or otherwise closed afterwards. The frame 14 is inflated by introducing an inflation gas through frame inflation passageway 42, which is sealed or otherwise closed afterwards.

An end user may open package 10, for example, by cutting top chamber sheet 18 to provide access to product 16. After removal of product 16, the inflated frame 14 may be punctured to deflate it. The deflated package 10 may then be ready for recycling.

The above descriptions are those of preferred embodiments of the invention. Various alterations and changes can be made without departing from the spirit and broader aspects of the invention as defined in the claims, which are to be interpreted in accordance with the principles of patent law, including the doctrine of equivalents. Except in the claims and the specific examples, or where otherwise expressly indicated, all numerical quantities in this description indicating amounts of material, reaction conditions, use conditions, molecular weights, and/or number of carbon atoms, and the like, are to be understood as modified by the word "about" in describing the broadest scope of the invention. Any reference to an item in the disclosure or to an element in

the claim in the singular using the articles "a," "an," "the," or "said" is not to be construed as limiting the item or element to the singular unless expressly so stated. All references to ASTM tests are to the most recent, currently approved, and published version of the ASTM test identified, as of the priority filing date of this application. Each such published ASTM test method is incorporated herein in its entirety by this reference.

CLAIMS

What is claimed is:

1. A package for containing a product, the package comprising:
   – top and bottom opposing flexible chamber sheets sealed together in a selected chamber seal zone to define a watertight chamber portion that is capable of containing the product; and
   – a hollow frame circumscribing the chamber portion and adapted to support the chamber portion when the frame is inflated.
2. The package of claim 1 wherein the frame comprises top and bottom opposing flexible frame sheets sealed together at a selected frame outer seal zone proximate the perimeter of the frame and at an selected frame inner seal zone proximate the chamber portion.
3. The package of claim 2 wherein:
   – a lid sheet comprises both the top frame sheet and the top chamber sheet;
   – a base sheet comprises both the bottom frame sheet and the bottom chamber sheet; and
   – the lid and base sheets extend continuously from the frame to the chamber portion.
4. The package of any of claims 2-3 wherein:
   – a lid sheet comprises both the top frame sheet and the top chamber sheet, wherein the lid sheet is formed from a lid web; and
   – a base sheet comprises both the bottom frame sheet and the bottom chamber sheet, wherein the base sheet is formed from a base web.
5. The package of any of claims 3-4 wherein:
   – the lid sheet is sealed to the base sheet at both the frame outer seal zone and the frame inner seal zone; and

– the frame inner seal zone is coextensive with the chamber seal zone.

6. The package of any of claims 2-5 wherein the top and bottom frame sheets are heat sealed together at the frame outer seal zone.
7. The package of any of claims 2-5 wherein the top and bottom frame sheets are adhesively sealed together at the frame outer seal zone.
8. The package of any preceding claim wherein the bottom chamber sheet is opaque.
9. The package of any preceding claim wherein the top and bottom chamber sheets each comprise one or more thermoplastic polymer materials.
10. The package of any preceding claim wherein the top and bottom chamber sheets each have an oxygen transmission rate of less than about 150 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C.
11. The package of any preceding claim further comprising a frame inflation passageway for inflating the frame.
12. The package of claim 11 wherein the frame inflation passageway comprises a one-way valve.
13. The package of any preceding claim further comprising a chamber inflation passageway for introducing a modified atmosphere into the chamber portion.
14. The package of any preceding claim further comprising a modified atmosphere in the chamber portion.
15. The package of any preceding claim wherein the frame is inflated to a pressure above ambient pressure.

16. The package of any preceding claim wherein the frame is inflated to a pressure of at least about 0.2 bar.
17. A packaged product comprising:
    – the package of any preceding claim; and
    – a product within the chamber portion.
18. The packaged product of claim 17 wherein the product is a food.
19. The packaged product of claim 17 wherein the product is a meat.
20. A process of packaging comprising:
    – providing a base web comprising a flexible sheet material;
    – placing a product on the base web;
    – positioning over the product a lid web comprising a flexible sheet material;
    – sealing the lid web to the base web at a selected chamber seal zone to form a chamber portion enclosing the product; and
    – sealing the lid web to the base web at one or more selected frame seal zones to form a hollow frame circumscribing the chamber portion and adapted to support the chamber portion when the frame is inflated.
21. The process of claim 20 further comprising folding at least a portion of the base web over the product to form the lid web.
22. The process of any of claims 20-21 wherein at least one of the selected frame seal zones is coextensive with the selected chamber seal zone.
23. The process of any of claims 20-22 wherein the sealing of the lid web to the base web at the selected chamber seal zone forms a chamber portion enclosing a modified atmosphere within the chamber portion.
24. The process of any of claims 20-23the sealing of the lid web to the base web at one or more selected frame seal zones forms the hollow frame enclosing gas at a pressure above ambient pressure.

25. The process of any of claims 20-24 further comprising introducing a modified atmosphere into the chamber portion.
26. The process of any of claims 20-25 further comprising inflating the hollow frame.
27. The process of any of claims 20-26 further comprising thermoforming at least a portion of the base web into a desired configuration before placing the product on the base web.
28. The process of any of claims 20-27 further comprising at least partially unwinding a base web roll to provide the base web.
29. The process of any of claims 20-28 further comprising at least partially unwinding a lid web roll to provide the lid web.
30. The process of any of claims 20-29 further comprising severing the base web to form a package base web portion and a remaining base web portion, wherein:
    – the hollow frame comprises the package base web portion; and
31. the remaining base web portion is outside of the package base web portion.
32. The process of any of claims 20-30 further comprising severing the lid web to form a package lid web portion and a remaining lid web portion, wherein:
    – the hollow frame comprises the package lid web portion; and
    – the remaining lid web portion is outside of the package lid web portion.
33. The process of any of claims 20-31 wherein the sealing to form the chamber portion and the sealing to form the frame are performed simultaneously.

PACKAGE HAVING AN INFLATED FRAME

* * * * * *

ABSTRACT OF THE DISCLOSURE

A package for containing a product such as meat. The package includes top and bottom opposing flexible chamber sheets. These sheets are sealed together in a selected chamber seal zone to define a watertight chamber portion that is capable of containing the product. A hollow frame circumscribes the chamber portion. The frame supports the chamber portion when the frame is inflated. The need for a rigid tray may be eliminated by the inventive package.

FIG. 1

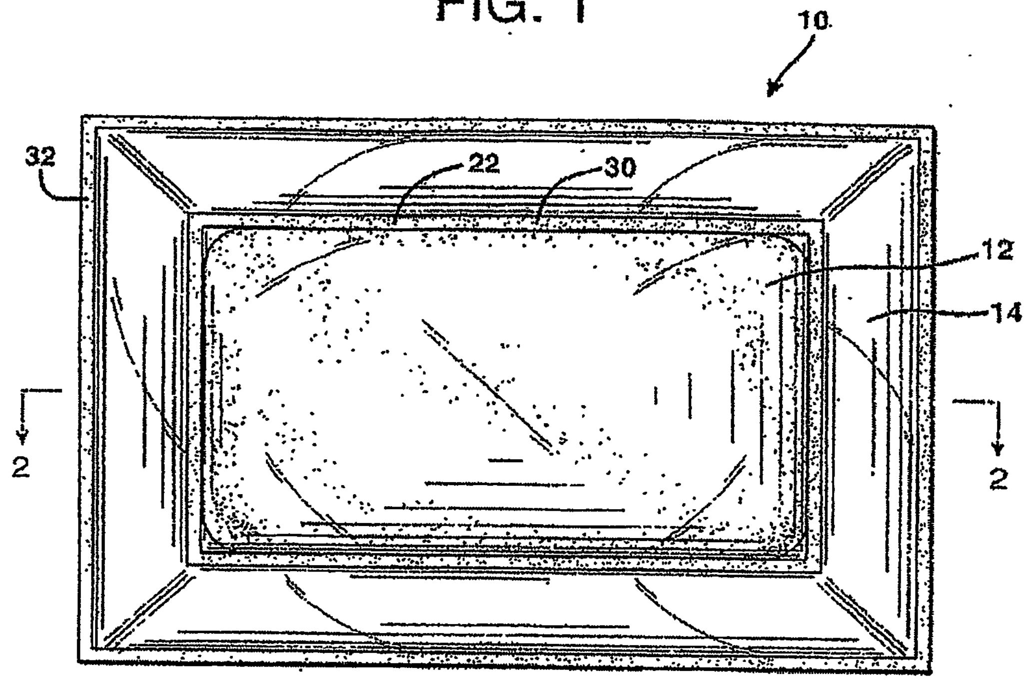
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FIG. 2

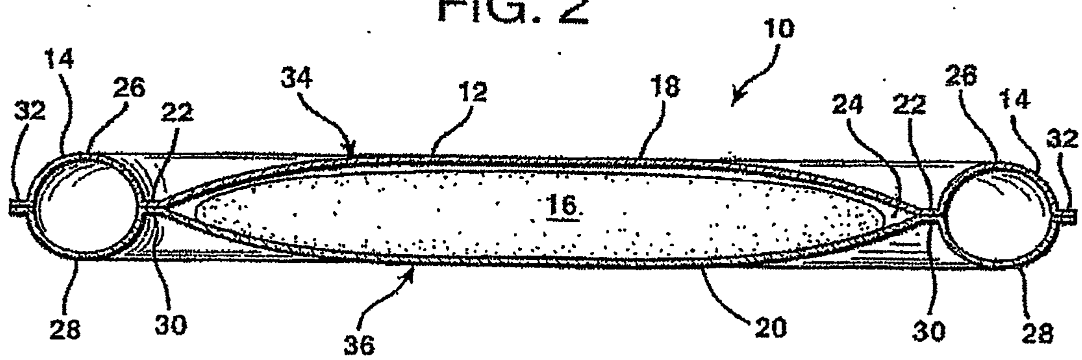
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FIG. 3

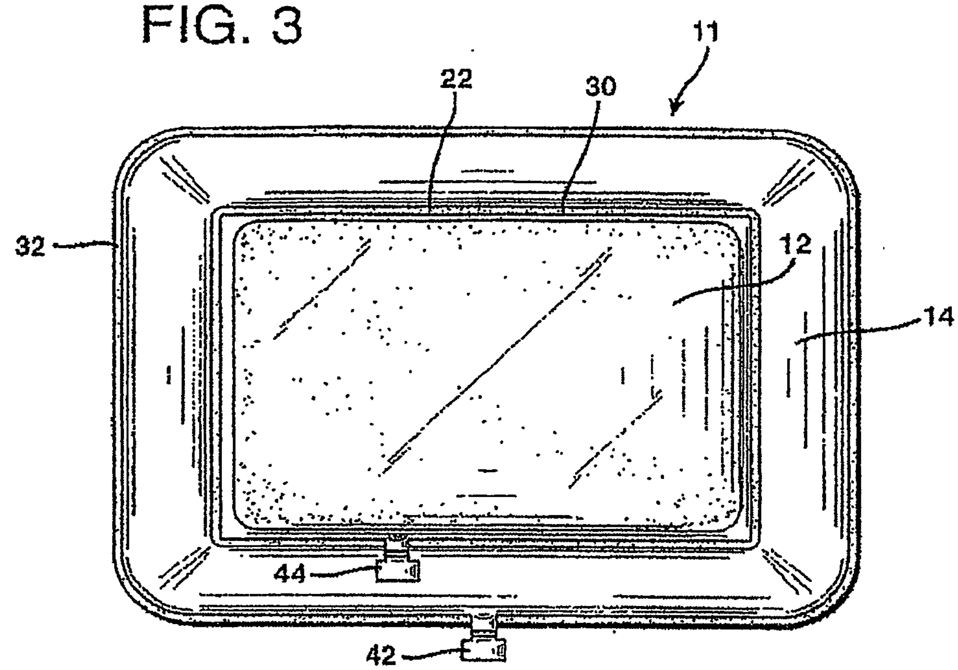

FIG. 4

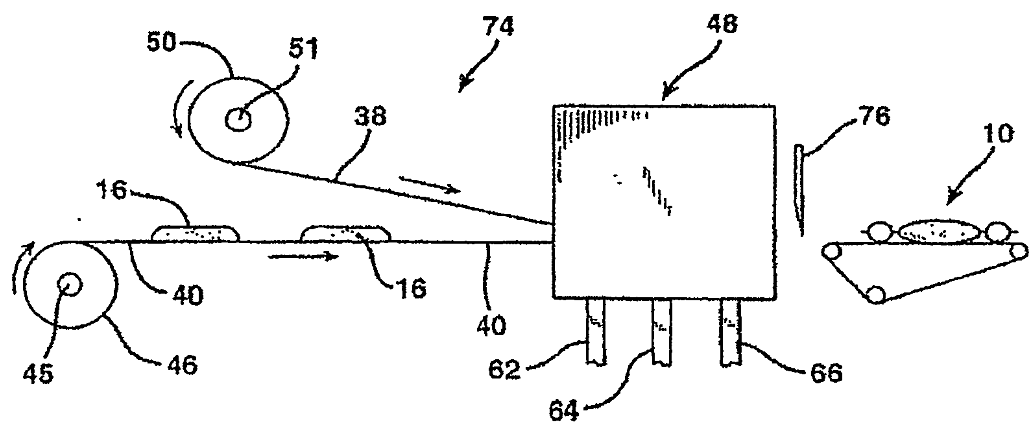

FIG. 5

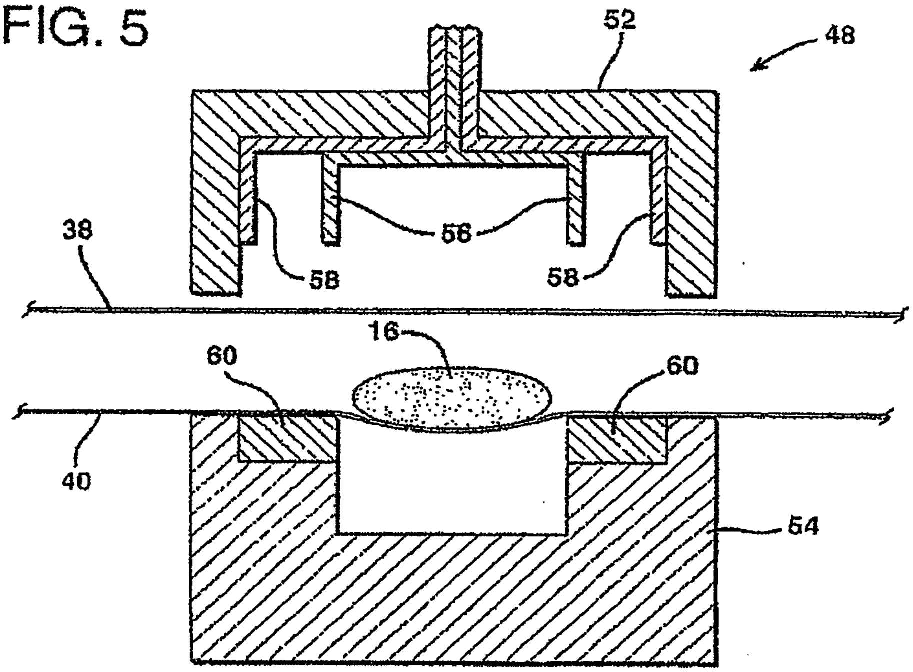
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FIG. 6

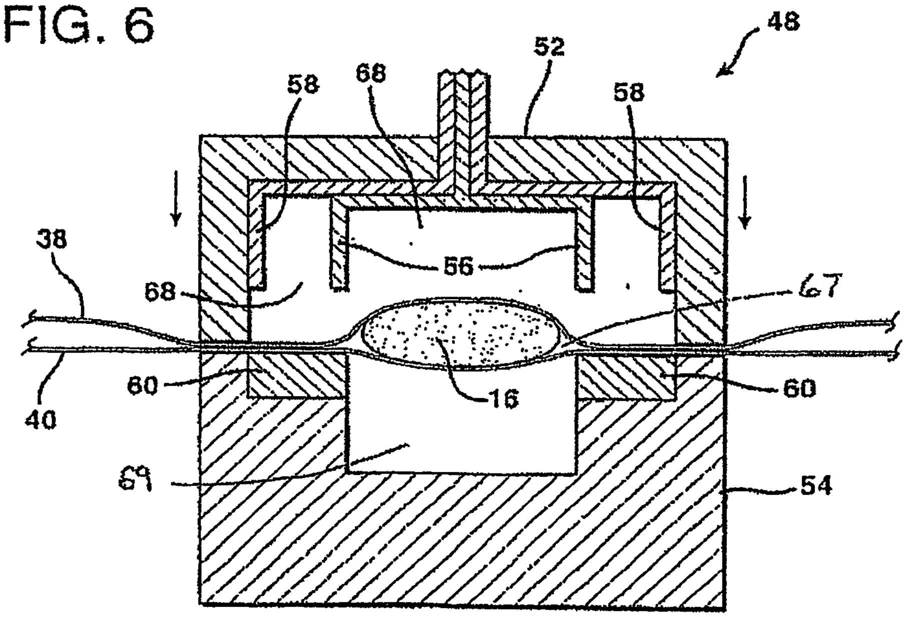
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FIG. 7

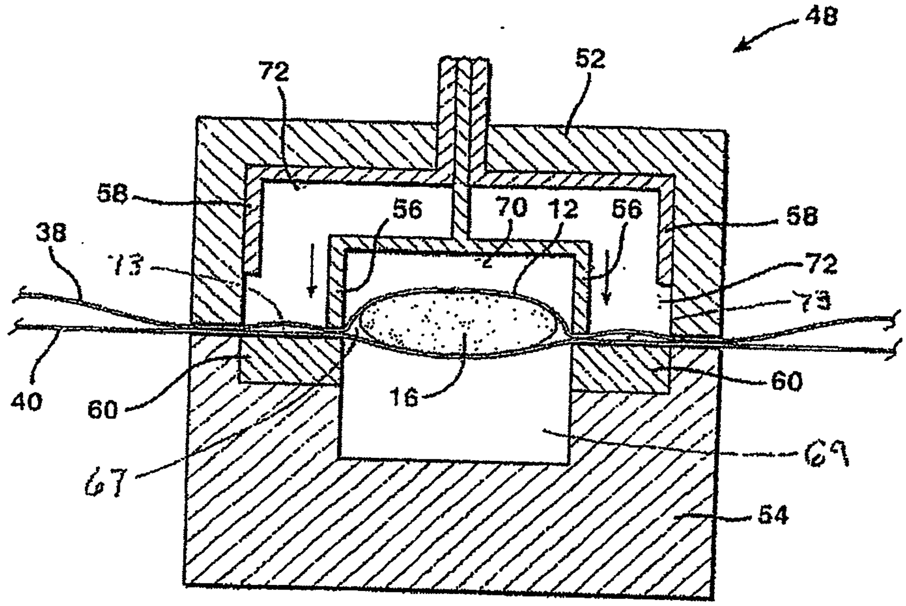
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FIG. 8

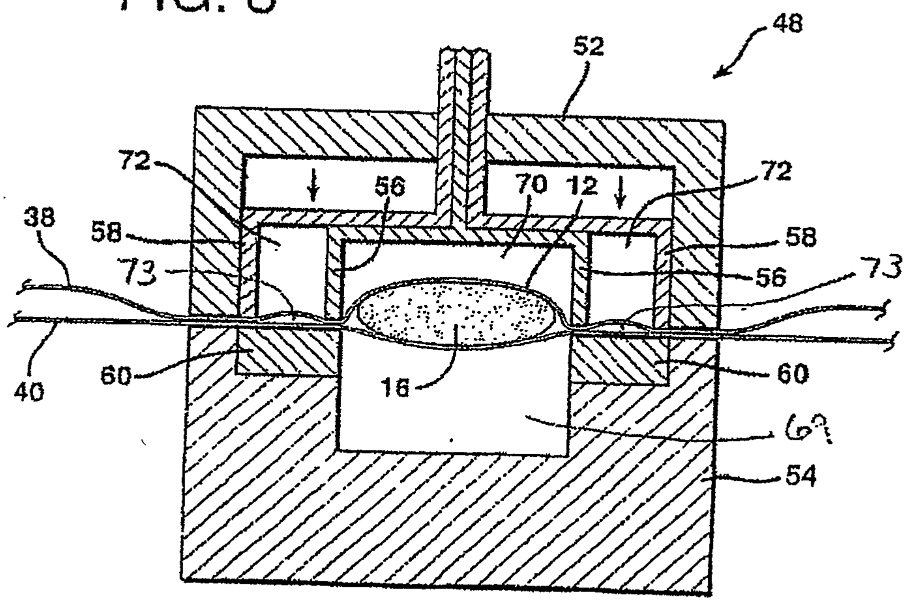
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FIG. 9

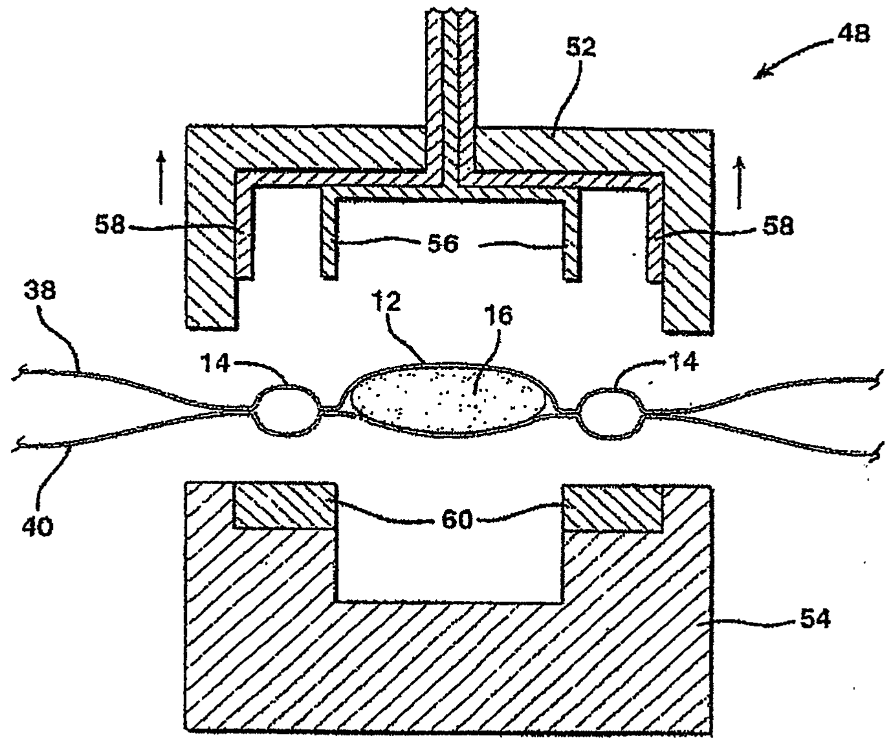

FIG. 10

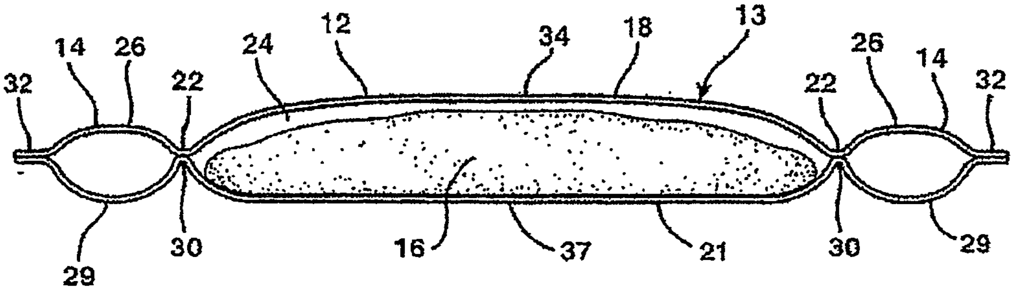

FIG. 11

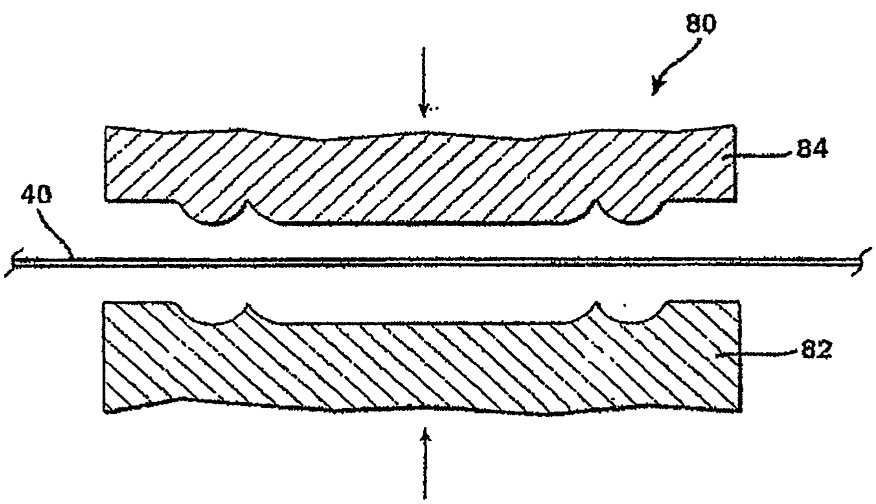

FIG. 12